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The ESA Huygens Probe Entry and Descent Trajectory Reconstruction

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Cassini/Huygens is a joint NASA/ESA mission on its way to explore the Saturnian system. The ESA Huygens probe is scheduled to be released from the Cassini spacecraft on December 25, 2004, will enter the atmosphere of Titan in January, 2005, and will descend to the surface of the planet using a sequence of different parachutes. To correctly interpret and correlate results from the probe science experiments and to provide a reference set of data for ``ground-truthing" Orbiter remote sensing measurements, it is essential that the trajectory reconstruction be performed as early as possible in the post-flight data analysis phase. The reconstruction of the Huygens entry and descent trajectory will be based primarily on the probe entry state vector provided by the Cassini Navigation Team, and measurements of acceleration, pressure, and temperature made by the Huygens Atmospheric Structure Instrument (HASI). Other datasets contributing to the entry and descent trajectory reconstruction include the mean molecular weight of the atmosphere measured by the probe Gas Chromatograph/Mass Spectrometer (GCMS) in the upper atmosphere and the Surface Science Package (SSP) speed of sound measurement in the lower atmosphere, and probe altitude by the two probe radar altimeters during the latter stages of the descent. Measurements of the zonal wind drift by the Doppler Wind Experiment (DWE), and probe zonal and meridional drift and probe attitude by the Descent Imager and Spectral Radiometer (DISR) will further constrain the probe trajectory. This paper outlines the mathematical approach and computational flow of an algorithm that combines all the relevant measurements to retrieve the optimum probe trajectory and its uncertainty.